



A.T. Grove

The Physical Geography of Africa

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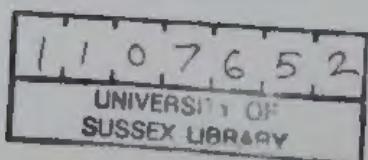
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Dedicated to

A. T. Grove



Contents

<i>List of Figures</i>	x
<i>List of Plates</i>	xv
<i>List of Contributors</i>	xvii
A. T. Grove	xix
C. VITA-FINZI	
1. Tectonics, Geology, and Long-Term Landscape Development	1
M. A. SUMMERFIELD	
2. The African Rift System	18
C. E. NYAMWESSI	
3. Climate: Past and Present	34
A. S. GOUDIE	
4. Environmental Change Within the Historical Period	60
R. E. NICHOLSON	
5. Climate Change Within the Period of Meteorological Records	88
M. HULME	
6. Hydrology and Rivers	103
D. S. WALLING	
7. Lakes	122
W. M. ADAMS	
8. Soils	134
O. AREOLA	
9. The Geomorphology of the Seasonal Tropics	148
A. S. GOUDIE	
10. Biogeography	161
M. Z. MEADOWS	
11. Forest Environments	173
A. GRAINGER	
12. Savanna Environments	196
M. E. ADAMS	
13. Desert Environments	211
N. LANCASTER	
14. Coastal Environments	238
A. R. ORME	
15. Wetlands	267
F. M. R. HUGHES	
16. Mountains	287
D. TAYLOR	
17. Mediterranean Environments	307
H. D. ALLEN	
18. Soil Erosion	326
M. A. STOCKING	
19. Desertification	342
A. WARREN	
20. Biodiversity and Biodepletion	356
N. MYERS	
21. Conservation and Development	367
W. M. ADAMS	
<i>Index</i>	383

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A. T. Grove

Claudio Vita-Finzi

'The study of the Earth on which we inhabit', argued Robert Hooke, 'is so large that the efforts of Observers, Watchers, Compilers, and Name-setters however numerous would yield but a heap of Confusion.' What was required, 'in the collecting of Materials as well as in the use of them, was some End and Aim, some pre-design'd Module and Theory, some Purpose. I could wish', he remarked, 'that the Information of Experiments might be more respected than either the Novelty, the Surprisingness, the Pomp and Appearances of them.'

Three centuries later Modelling is indeed in the ascendant. But happily it has not suffocated exploration, or obscured the fact that, as Hooke himself says elsewhere, 'there are some Men who excel in their Observations and Deduction'. And, as the work of A. T. Grove resoundingly shows, these several activities are most fruitful if practised in unison. For he has carried out some outstanding feats of exploration, formulated and tested climatic models which are widely accepted, and retained a youthful capacity to be surprised by the Earth and our place on it, in a professional life where everything fits and nothing jars.

Alfred Thomas Grove, known universally and to many of his friends inexplicably as Dick, was born in Evesham, Worcestershire, on 8 April 1924, the son of a market gardener. He was educated at Prince Henry's Grammar School in Evesham. In 1941 at the age of 17 Grove entered St Catharine's College, Cambridge. A year later he was called up to the Royal Air Force and served in the RAFVR, attaining the rank of Flight Lieutenant. In 1945 he returned to Cambridge and in 1947 he graduated with a First Class Honours degree in Geography. During 1947-9 he was attached to the Nigerian Geological Survey to report on soil erosion. He returned as Demonstrator to the Department of Geography in Cambridge where, barring a spell of six months at the University of Legon in Ghana, a semester at UCLA, and countless field trips, he has remained. He was made lecturer in 1954 and is now a Senior Research Associate. He was Director of the Centre for African Studies during 1980-6. Elected a Fellow of Downing College in 1963 he has served successively as Tutor, Senior Tutor, and Vice Master. He has edited, chaired, and co-ordinated countless things unobtrusively and effectively.

Soon after taking up his Cambridge post Grove was introduced to his future wife Jean, then a research student, by Vaughan Lewis. Jean was planning to take an expedition to the Jotunheimen to look at cirque glaciers and Grove joined her on the first of many glaciological journeys on which, in the 1960s and 1970s, they took their growing family. The trips with Jean were fitted into an already crowded schedule of field-work which included work on geomorphology and climatic change in the Tibesti Mountains between Libya and Chad in 1957, and in northern Nigeria in 1960; on Quaternary landforms in East Africa in 1961, northern Nigeria in 1963, East and South-Central Africa in 1965, the Kalahari and South-West Africa in 1967, Botswana in 1972, and Malawi in 1977; and on Quaternary lake levels in Ethiopia in 1970, and 1974, Tanzania in 1978, Kenya and Sudan in 1980, and Patagonia in 1981. Following Grove's partial retirement his collaboration with Jean has gained momentum, notably on desertification and climatic change in a series of projects funded by the European Community.

An African Canvas

The range of topics on which Grove has published is as wide-ranging as his field-work and just as deceptively so. Running through his papers and books, whatever the level at which they are written, is a concern for the human response to a difficult and unreliable world. Africa led him into that painful pursuit and it has continued to supply much of the narrative.

The analysis may be sensitive but it remains detached. When *Africa South of the Sahara* came out in 1967 Grove found reasonable grounds for being optimistic about the future. By the time of the third edition in 1979 most African countries were facing grave financial difficulties. By 1989 action was needed 'to prevent the continent and its people receding to the margins of the modern world'. 'We seem to be witnessing', Grove wrote in *The Clumping Geography of Africa*, 'processes that involve the disappearance for ever of much that is of value and interest in the geography of mankind.' Here is a zoologist talking without sentimentality about a threatened sub-species.

The newer book was intended for schools and colleges. It discarded regions and countries in favour of various fields of economic activity, and elements of the present crisis such as drought and aid. The need to communicate this concern may partly explain the care lavished by Grove on his textbooks in the first place. Extensive travel in Africa and wide and deep reading in its vast literature have given Grove an uniquely synoptic view of the physical geography of Africa. His introductory chapter on the geomorphological evolution of the Sahara and the Nile in the symposium by Williams and Faure (1980), like his more recent study of the African Rift System (1986), has the lightness of touch that comes from a secure grasp of a shifting literature.

The eloquence and unobtrusive didacticism of these general studies, often clothed in illustrations, are also deployed in Grove's more exotic writings. Two memorable examples are the articles on the 'Geomorphology of Tibesti' and 'The Ancient Erg of Hausaland'. The latter, an excellent account of what palaeoclimatology stands to gain from regional analysis of shifts in wind direction, included a bold map of dunefields which, like the crescents that are said to scar the retinas of those who have gazed at a solar eclipse, has doubtless benevolently scared many impressionable minds. The Tibesti paper, which RAFishly made light of a tough journey ('arrived back in Tripoli, having suffered no serious mishaps'), included an aerial photograph of topographic alignments which has proved equally memorable.

The recurrence of themes is of course more an African dictate than a personal foible. Grove published a paper on farming systems and soil erosion in Nigeria in 1949, took up the subject in a series of papers in the 1950s, pursued it together with the vexed issue of desertification in his textbooks in the 1960s and 1970s, and is now confronting it in a Mediterranean context in the 1980s and 1990s.

Lakes and Dunes

The analysis of former climatic patterns will probably prove Grove's greatest contribution to earth science by its bearing on land degradation and human adaptive strategies. He recognized palaeowinds and palaeolakes as critical to the reconstruction of Pleistocene circulation patterns. Unlike oceanic indicators, they represent local conditions rather than a global average and, unlike isotopes or faunas, they reflect with reasonable faithfulness the very climatic factors we seek to recover. He was not alone, or the first, to do so but he set about recovering these data for a substantial chunk of the world with exemplary thoroughness.

The Tibesti area had provided abundant evidence of shifts in wind pattern and

fossil landforms. Fossil lakes and dunes came together most productively in Grove's studies of the former Lake Chad, which begat a long series of collaborative writings with several of the authors of this volume in Africa, Australia, and southern Europe. What distinguishes this corpus from that of other groups? The accounts have something of Grove himself: dismissive of any physical difficulties encountered in their preparation, they include the essential information shorn of flummery yet embodying all the background information one might require. They were also solidly rooted in radiocarbon dates at a time when correlation by height or stratigraphic position was still prevalent in Quaternary studies. All three attributes have contributed to the durability of the work. In the words of H. H. Lamb (in Grove *et al.* 1975: 199), 'Mr. Grove is exploiting [radiocarbon dating and other new techniques] in a programme that promises to clarify our fundamental understanding of how the world's climatic regime and global wind circulation work and link together.'

Chronology proved especially diagnostic in the lake work. For decades the fossil shorelines of East Africa had invited flamboyant correlation on the basis of preconceived notions or, at best, a handful of worked flakes at their periphery. The climatic record of low latitudes was thereby compromised. By dint of what Lamb called 'patient, long-continued, detailed work' Grove and his associates have replaced surmise by numbers. The early papers (e.g. Grove and Warren, 1968) cited a handful of dates, mostly obtained in overseas laboratories; the Ethiopian study (Grove *et al.*, 1975) relied on almost 100 ^{14}C ages for Ethiopia and East Africa. A review of Quaternary lake-level fluctuations ten years later cited 238 ^{14}C ages for lake-levels in intertropical Africa and, in a global survey of lake-levels since 30 000 sr containing 119 data points and 1265 dates, Africa contributed 64 data points with 563 dates (Street and Grove, 1976, 1979).

This is not simply a matter of quantity: the ages were carefully selected. More to the point, the quality of the African contribution could be vouched for because the bulk of it had been gathered by Grove and his associates. The findings invalidated such practices as the correlation of Middle Eastern lake sequences with those of North America and supported the correspondence between high lake-levels in Africa and interglacial or interstadial phases. They also scotched any lingering belief in a simple climatic interpretation of the lake record.

European Perspectives

The palaeoclimatic work, though dispassionate, has never been dissociated from its human implications. In a survey of semi-arid lands he presented for a symposium on resource development a few years ago Grove devoted a substantial section to climatic change before innocently citing a UN report which argued for an integrated approach to planning.

The soft sell is no longer needed. If anything some of the goods have to be recalled. The inverted commas around desertification in Grove's 1986 paper on Europe draw discreet attention to the risk of substituting melodrama for justifiable anxiety about loss of productivity in recent centuries. Grove's collaboration with his wife on medieval climate in Europe is being conducted with a sobriety and persistence not normally associated with the autumnal serenity of retirement.

The tenor of the enterprise is wholly contrary to Byron's languid 'retirement accords with the tone of my mind'. We should welcome Grove's interest in the European past also for entirely selfish reasons. Europe, unlike much of Africa, offers some prospect of yielding well documented palaeoclimatic sequences at high and low elevations and on a variety of terrains. The fine grinding of the Grove school may at last find grain worth the milling. Let us hope that the result will not lie unremarked in the grey binding of

conference proceedings and interim reports. The relaxed and unassuming air of many of Grove's classic papers, and the limited circulation of the periodicals in which he has chosen to publish them, has undoubtedly muted their impact: the determination to communicate scientific ideas to a wide audience has been at the expense of the international dialogue with climatologists and geophysicists that is only now unfolding.

When in 1942 Dick Grove joined the Royal Air Force he was sent to Canada for pilot training; he spent much of his war service as a flying instructor and, in due course, as an instructor of instructors. *The Physical Geography of Africa* embodies work done by Grove, the research students he supervised, and their research students. And the reader will repeatedly recognize the hallmark of a classic Grove paper: an elegant, unruffled landing in an uncharted location despite treacherous (intellectual) cross-winds and an almost empty (funding) tank.

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References

- Grove, A. T. (1949). 'Farming Systems and Soil Erosion on Sandy Soils in Southeastern Nigeria', *Bulletin Agricole du Congo Belge*, 40: 2050.
— (1958). 'The Ancient Egg of Hausaland, and Siwalik Formations on the South Side of the Sahara', *Geographical Journal*, 124: 526–31.
— (1960). 'Geomorphology of the Tibetan Region with Special Reference to Western Tibet', *Geographical Journal*, 126: 18–31.
— (1977). 'The Geography of Semi-arid Lands', *Philosophical Transactions of Royal Society of London*, B 278: 457–75.
— (1978). *Africa* (3rd edn. of *Africa South of the Sahara*) (Oxford).
— (1980). 'Geomorphic Evolution of the Sahara and the Nile', in M. A. J. Williams and H. Faure (eds.), *The Sahara and the Nile* (Rotterdam), 7–16.
— (1986a). 'Geomorphology of the African Rift System', in L. E. Frostick et al. (eds.), *Sedimentation in the African Rifts* (London), 9–16.
— (1986b). 'The Scale Factor in Relation to the Processes Involved in "Desertification" in Europe', in R. Fantechi and N. S. Margalef (eds.), *Desertification in Europe* (Dordrecht), 9–14.
— and Pollan, R. A. (1963). 'Some Aspects of the Pleistocene Paleogeography of the Chad Basin', in P. Howell and P. Bourliere (eds.), *African Ecology and Human Evolution* (London), 230–46.
— and Warren, A. W. (1968). 'Quaternary Landforms and Climate on the South Side of the Sahara', *Geographical Journal*, 134: 194–208.
Street, F., Alayne, and Goudie, A. S. (1975). 'Former Lake Levels and Climatic Change in the Rift Valley of Southern Ethiopia', *Geographical Journal*, 141: 177–202.
Grove, J. M., Grove, A. T., and Conterio, A. (1992). 'Little Ice Age Climate in the Eastern Mediterranean', in T. Mokami (ed.), *Proceedings of the International Symposium on Little Ice Age Climates* (Tokyo) 221–6.
Street, F., Alayne and Grove, A. T. (1976). 'Environmental and Climatic Implications of Late Quaternary Lake-level Fluctuations in Africa', *Nature*, 261: 185–90.
— (1979). 'Global Maps of Lake-level Fluctuations since 30 000 yr a ', *Quaternary Research*, 12: 81–118.